Shuttle Small Payloads Project Office
The Future: Hitchhiker Space Station & Hitchhiker SHELS

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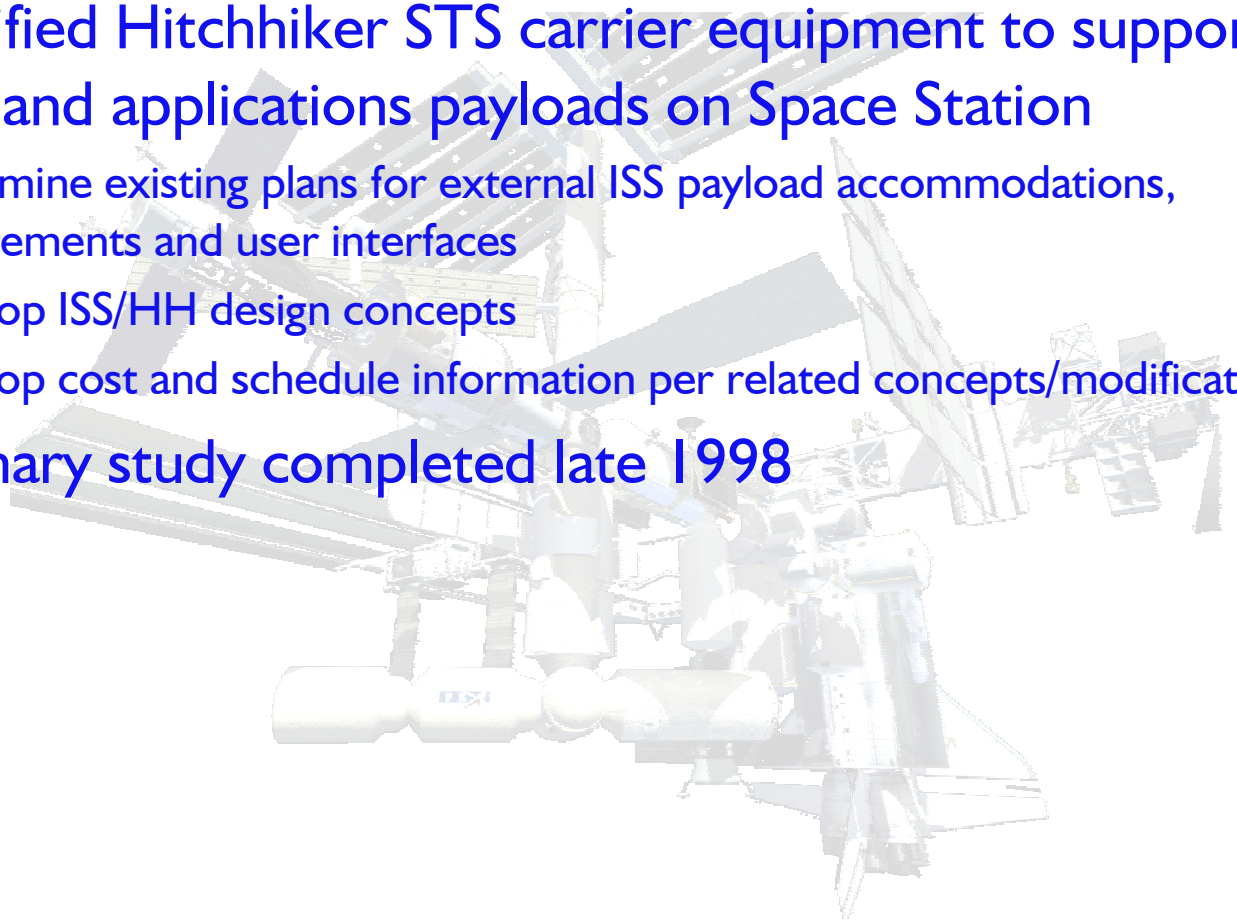
Chris Dunker, Office Chief
Gerry Daelemans, Assistant Office Chief
Shuttle Small Payloads Projects Office

Hitchhiker Space Station: Background

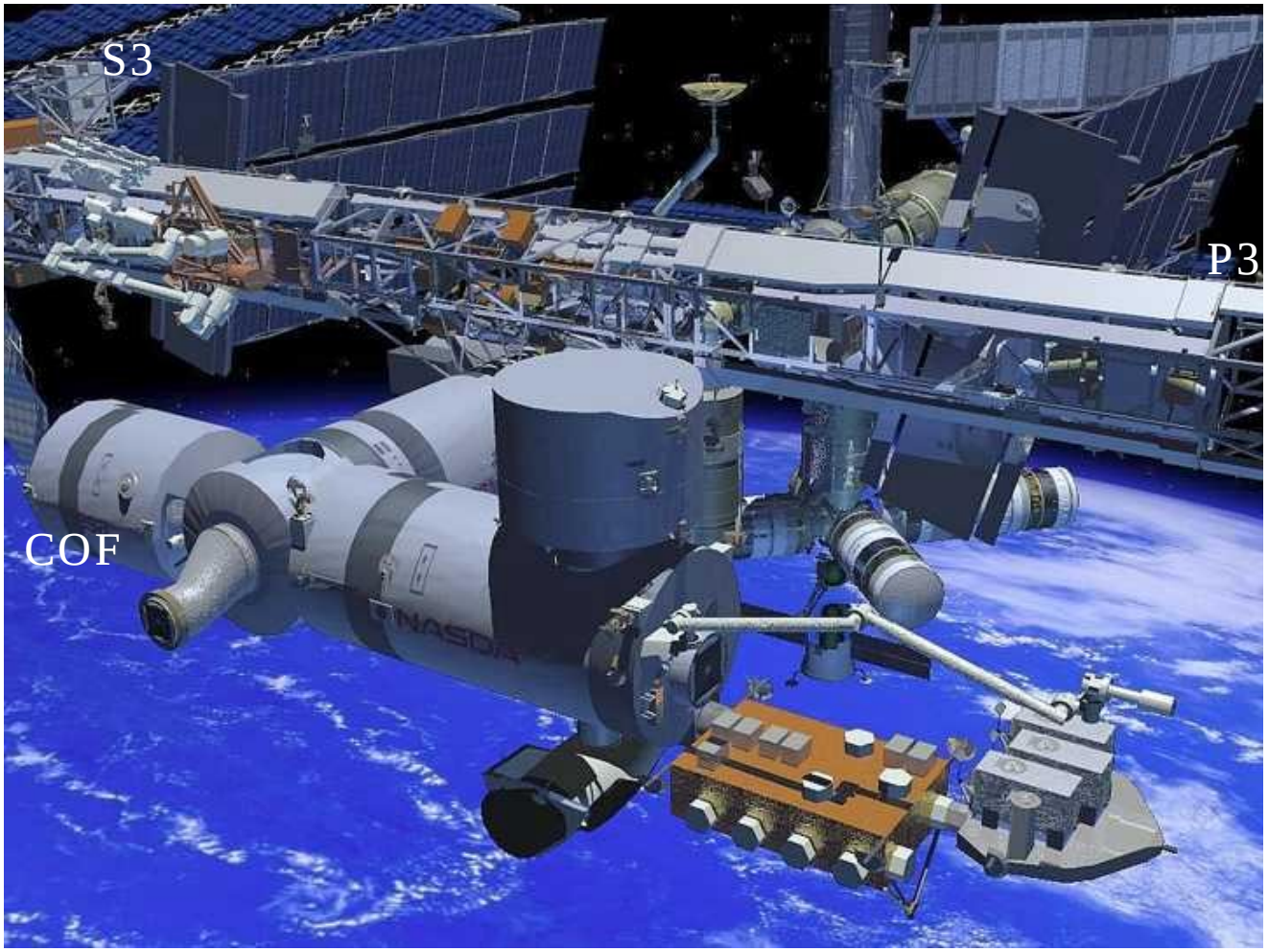
- Code M funded study to ascertain potential for using existing or modified Hitchhiker STS carrier equipment to support science and applications payloads on Space Station
  - Determine existing plans for external ISS payload accommodations, requirements and user interfaces
  - Develop ISS/HH design concepts
  - Develop cost and schedule information per related concepts/modifications
- Preliminary study completed late 1998



Study Guidelines and Goals

- Low cost approach
- Make maximum use of existing Hitchhiker resources
- Avoid duplicating existing ISS carrier services
- Provide for easy transition of existing and new Hitchhiker STS payloads to ISS
  - provide backward compatibility of user electrical interfaces
  - provide backward compatibility for user mechanical interfaces
  - provide backward compatibility of ground systems interfaces
- Maximize manifesting potential through appropriate design choices
- Provide solution that supports NASA science community (S,Y,etc) ISS endeavors

ISS Attached Payload Sites



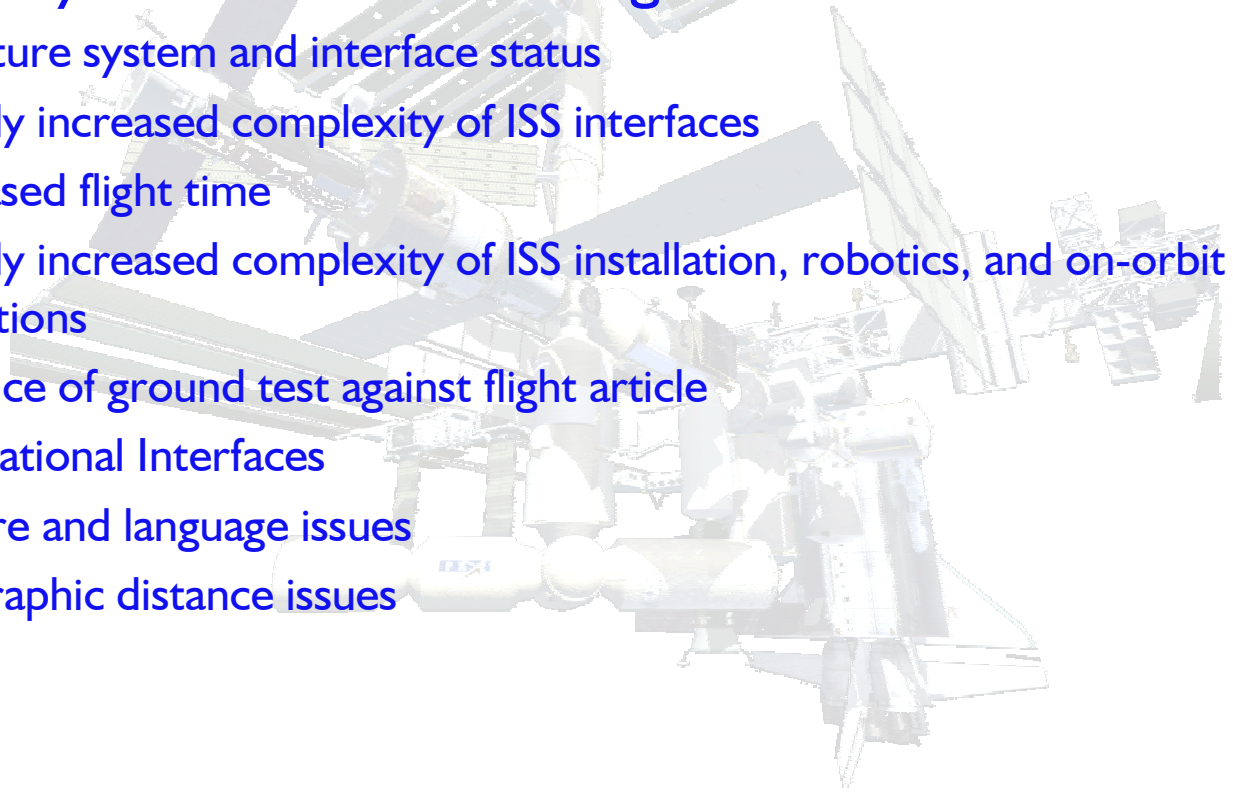
JEM-EF ELM-ES

Summary/Status of Preliminary Study

- Direct mount truss (S3), Japanese Experiment Module - Exposed Facility (JEM-EF), Columbus Orbiting Facility (COF), and Express Pallet Adapter sites all have different mechanical and electrical interfaces
- Express Pallet Carrier servicing truss S3 sites via Express Pallet Adapter; Express Pallet Adapter used for COF sites
- JEM EF (10 sites:5 for NASDA, 5 for NASA: 8 500 kg & 2 2500kg slots) not presently being serviced by carrier organization and under subscribed - therefore a need for a "Hitchhiker like" ISS Carrier. NASDA does payload integration on JEM-EF
- JEM-EF launch scheduled for June '03
- Extensive interest & support within Hitchhiker STS community, including GSFC investigators, for Hitchhiker JEM carrier systems and services
- Hitchhiker STS cross bay structure may be used as 2500 Kg JEM EF payload logistics carrier (JSC has no solution for this situation)

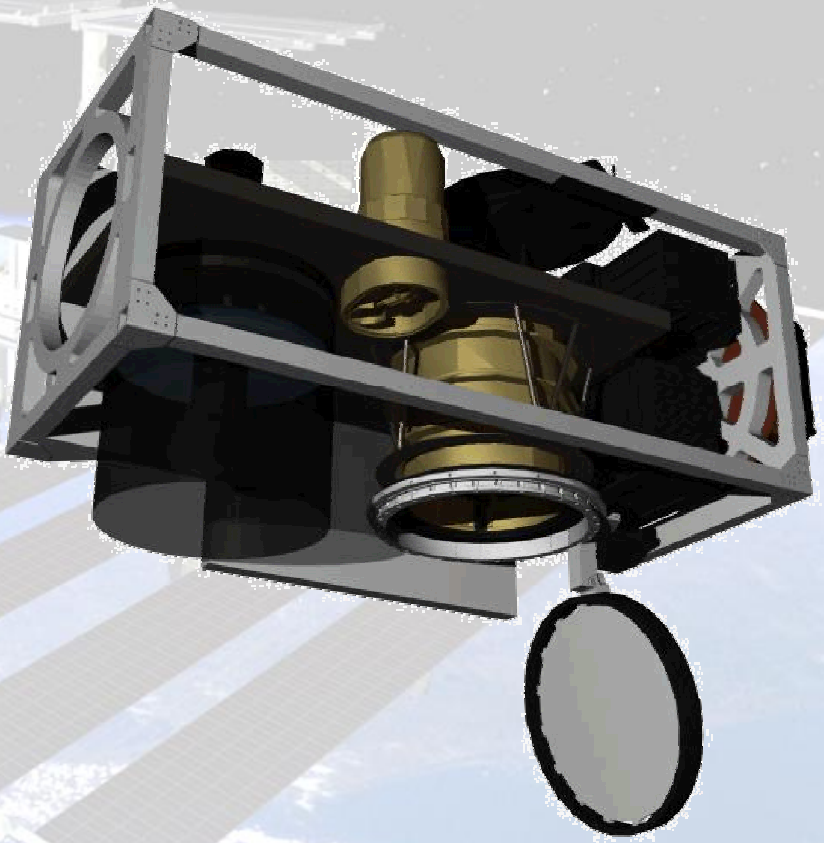
Need for SSPPO Type Function on JEM-EF

- The Need for an SSPPO Type Payload Function/Service for NASA ISS JEM EF payloads is even greater than for small Shuttle Payloads for the following reasons:
  - Immature system and interface status
  - Greatly increased complexity of ISS interfaces
  - Increased flight time
  - Greatly increased complexity of ISS installation, robotics, and on-orbit operations
  - Absence of ground test against flight article
  - International Interfaces
  - Culture and language issues
  - Geographic distance issues



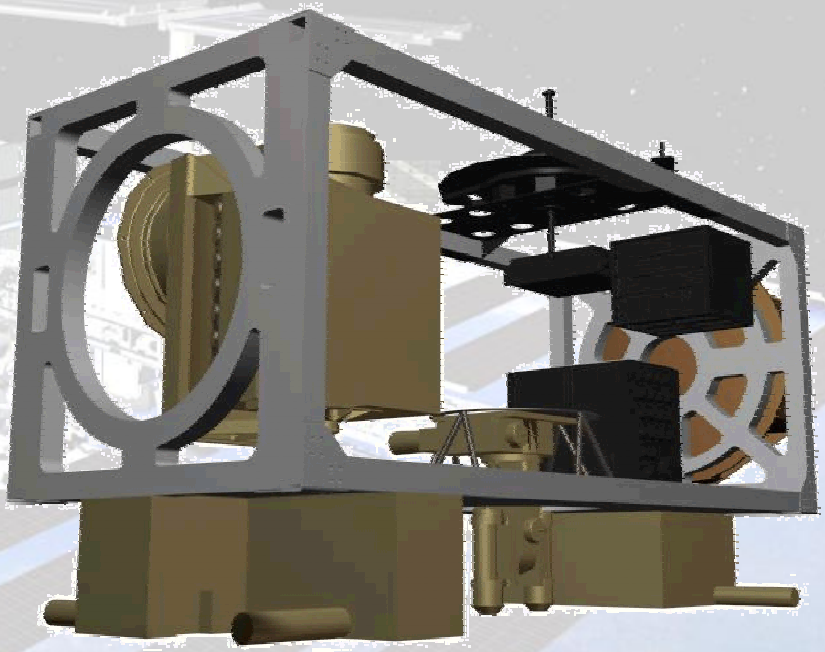
HH JEM Imaging Surface Lidar Experiment
Dr. Bufton NASA GSFC Code 920

- LAND-USE & LAND-COVER
  - Responses of terrestrial ecosystems after disturbance
  - Assess changes in above-ground carbon stocks
  - Regional forest inventory
- DIGITAL TOPOGRAPHY
  - Three-dimensional terrain imaging
  - Global grid of digital elevation tie points
  - High-resolution narrow-swath coverage of dynamic topography
  - Comparative geomorphology
- LASER TECHNOLOGY PATHFINDER
  - Sensor fusion of laser probing with multi-spectral imagery
  - In-space qualification of next-generation laser pulse transmitters
  - Demonstrate aggregate measurement rates and precision for change detection

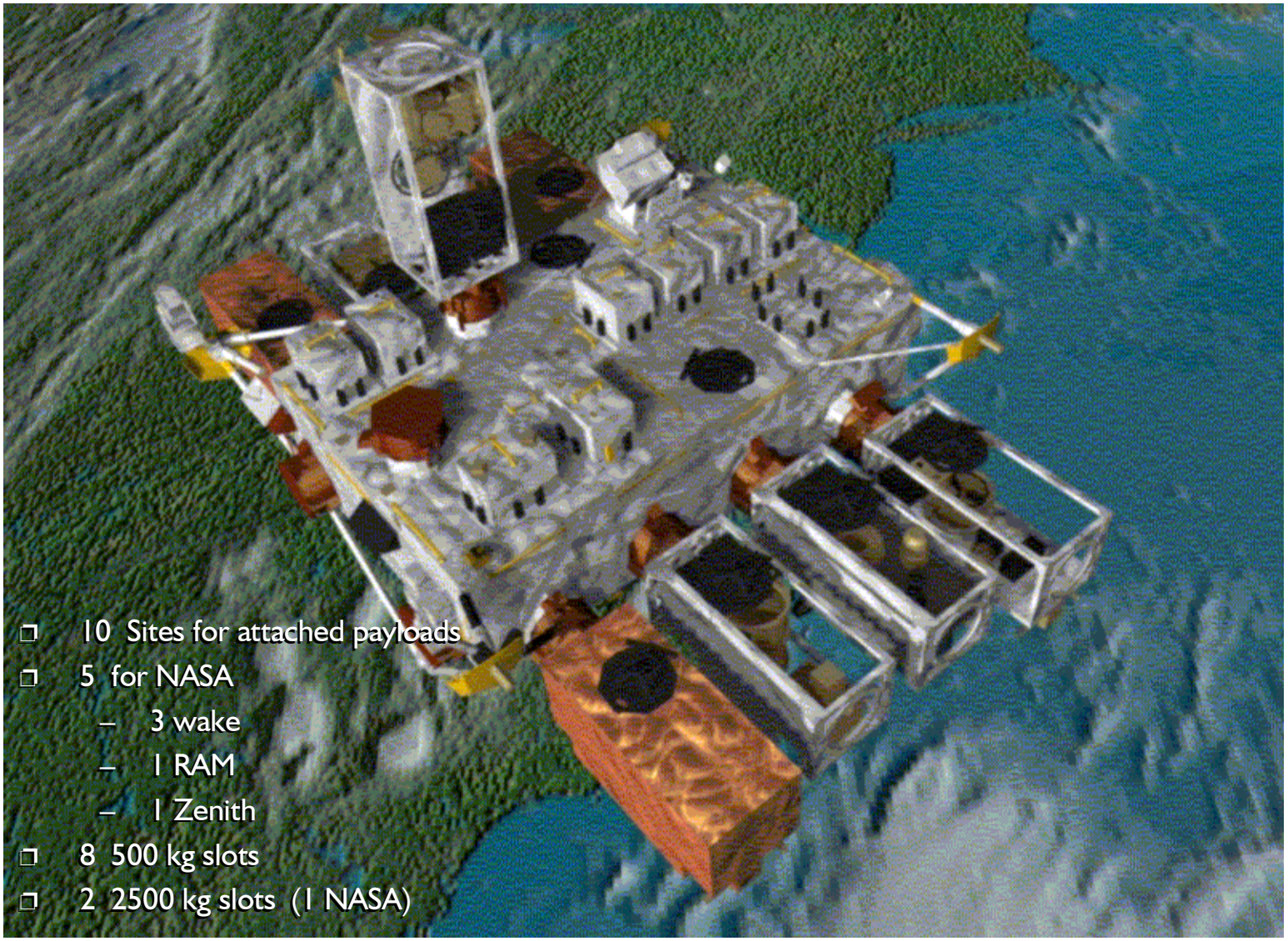


HH JEM Arizona Air-Glow Facility (GLO)
Dr.Broadfoot Lunar Planetary Laboratory & Canadian Space Agency

- Wide bandwidth (115-900 nm) hyper-spectral imaging spectrograph, complementary monochromatic imagers, and EUV solar flux monitor
- Measure the spatial and temporal variations of constituent number densities and temperatures in the thermosphere (60-300 km)
- The GLO measurement set will be used in the larger goal of predicting Earth's atmospheric response to solar activity

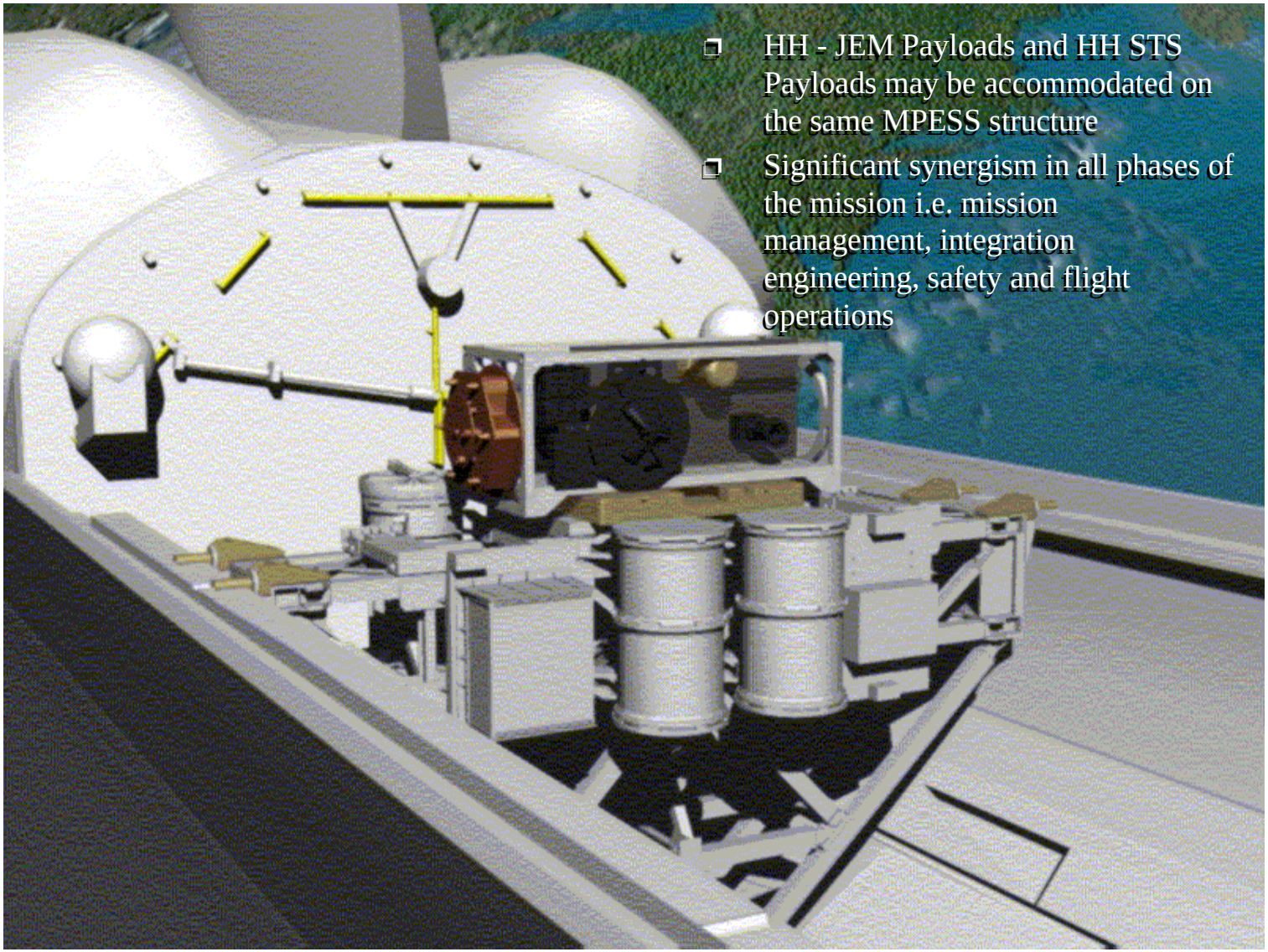


JEM - EF & HH JEM Payloads



- 10 Sites for attached payloads
- 5 for NASA
  - 3 wake
  - 1 RAM
  - 1 Zenith
- 8 500 kg slots
- 2 2500 kg slots (1 NASA)

HH STS and ISS Experiments



- HH - JEM Payloads and HH STS Payloads may be accommodated on the same MPESS structure
- Significant synergism in all phases of the mission i.e. mission management, integration engineering, safety and flight operations

ISS/HH JEM Programmatic Vision

- The Hitchhiker Program (OSF) would develop a HH JEM-EF carrier which will accommodate up to four instruments on one JEM-EF port with simple, Hitchhiker type, mechanical, electrical, and thermal interfaces
- The Hitchhiker Program will help investigators with documentation, safety, and interfaces, and provide instrument to carrier integration in a manner similar to the continuing Shuttle Hitchhiker Program and sharing existing GSFC Hitchhiker facilities and personnel
- OSF to fund HH JEM carrier system development, ground systems, and recurring standard integration and support, but end user organizations will need to fund excess (non-standard) integration and operations costs and recurring carrier hardware costs - to be advertised in future Code S/Y AO venues
- At any moment in time, one HH JEM payload would be on orbit while a second replacement HH JEM payload would be in integration phase at GSFC. On orbit swap via HH STS MPESS mission
- Manifesting and Utilization issues are handled by existing NASA HQ and JSC infrastructures
- Incorporate Outreach component as is tradition for SSPPO

ISS/HH-JEM Advantages

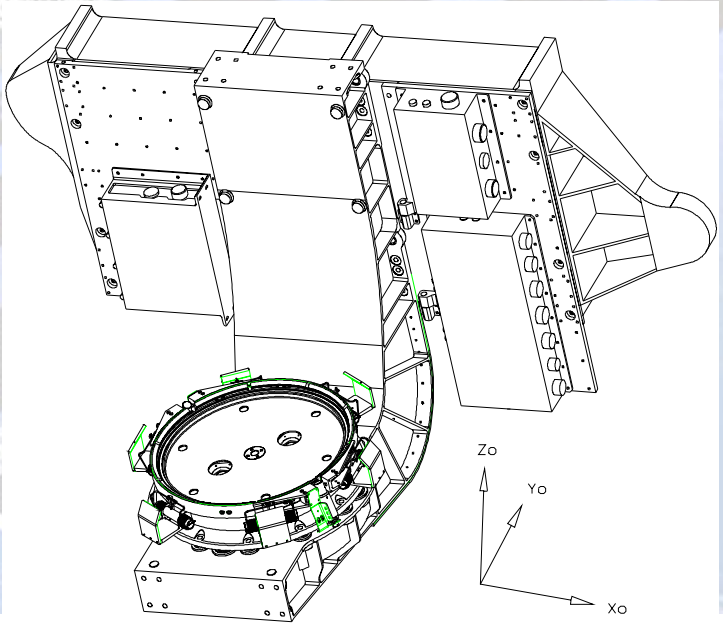
- Provides capability for accommodating multiple instruments on a single JEM-EF mounting position
- Payload interfaces are to the US ISS/HH-JEM (simple integration) and not directly to the Japanese JEM EFU (difficult integration)
- Avoids recurring experimenter effort and “wheel reinvention” costs associated with difficult mechanical, thermal, electrical, robotic, logistics, operations, interface testing and safety interfaces conducted across an international boundary
- Allows for capture and growth of an experienced ISS Attached Payload team resulting in more efficient use of resources and lower cost missions for experimenters

ISS/HH-JEM Advantages

- Allows Investigators to focus their monies on instrument development and not the mission integration effort, thus making their proposals more competitive within the AO venues
- Slips in ISS schedule would have less of an impact on investigator costs. Investigator could easily opt to fly on STS Hitchhiker
- Synergism with ongoing Hitchhiker STS program:
  - reduces cost to start up & implement a HH JEM based carrier service
  - allows for easy mixing of STS Hitchhiker and ISS/HH JEM payloads in cargo bay
  - provides fall back flight opportunities in the event of ISS assembly delays

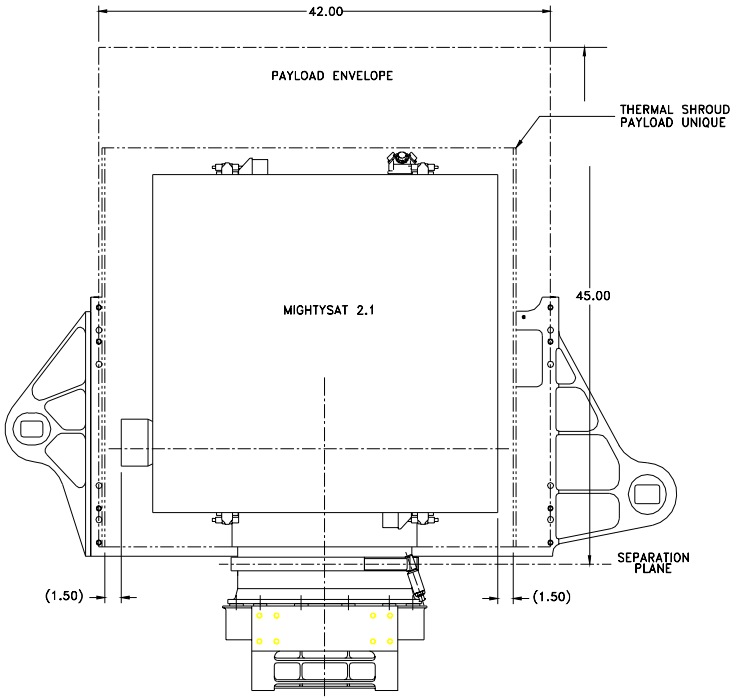
Shuttle Hitchhiker Experiment

- Shuttle Hitchhiker Experiment Launcher System (SHELS)
  - Co-sponsored development by NASA/GSFC and DoD (USAF SMSC/OL-AW)
  - Flight Ready by January 2000
  - Side-mounting shelf designed to eject up to a 400 lb. (maximum) satellite from the Shuttle Payload Bay
  - Center of gravity 24 inches above the separation plane; +/- 0.25 inches off ejection axis centerline
  - Payload envelope:
    - *42.0" (orbiter +/-x)*
    - *26.0" (orbiter +/-y)*
    - *45.0" (orbiter +/-z)*
  - Power and data umbilical available (optional cost)
  - 280 Watts radiated heater power if no umbilical

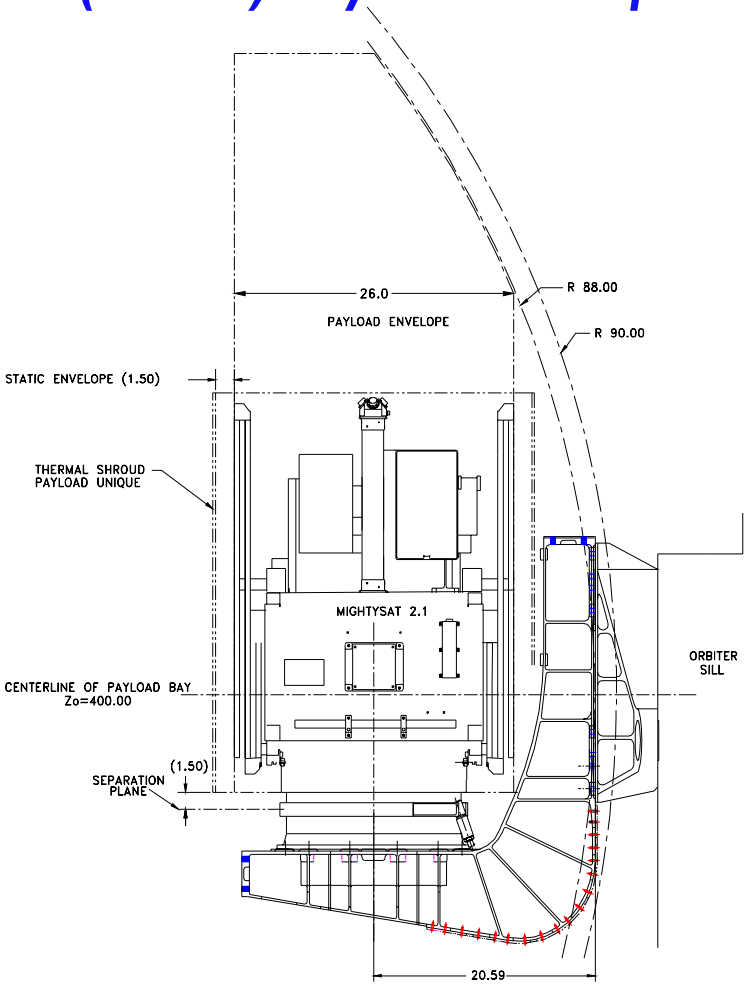


Future Enhancements

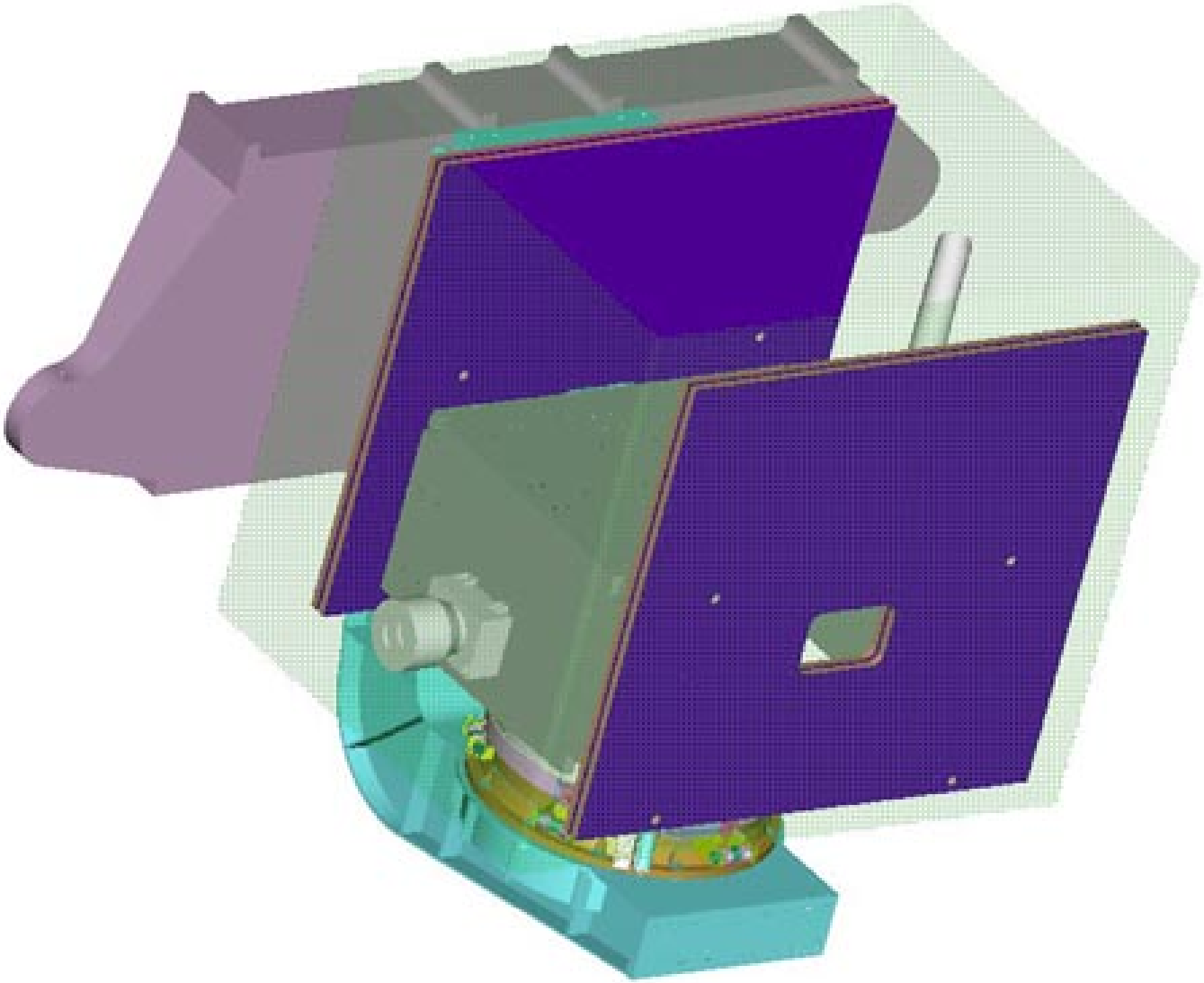
- ***Shuttle Hitchhiker Ejection System (SHELS) Payload Envelope***

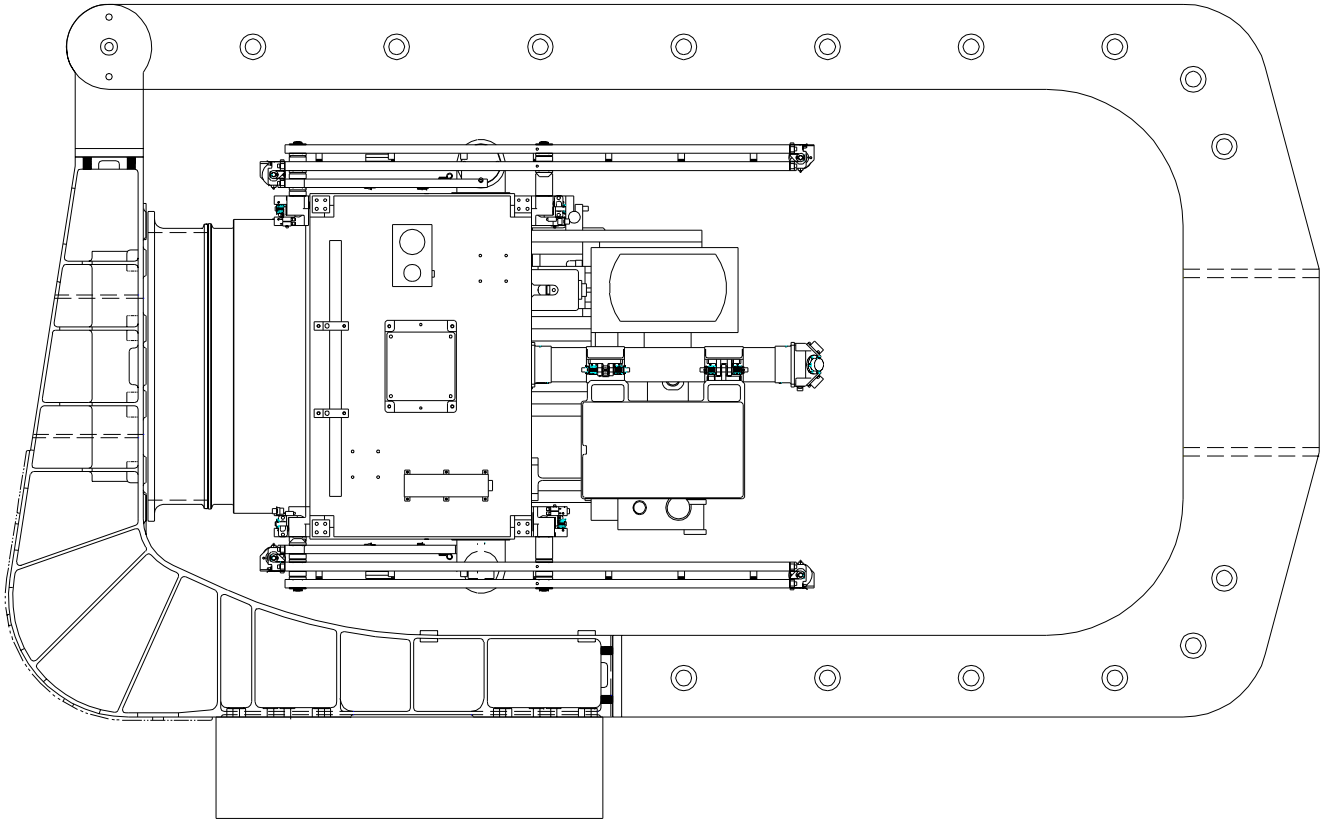


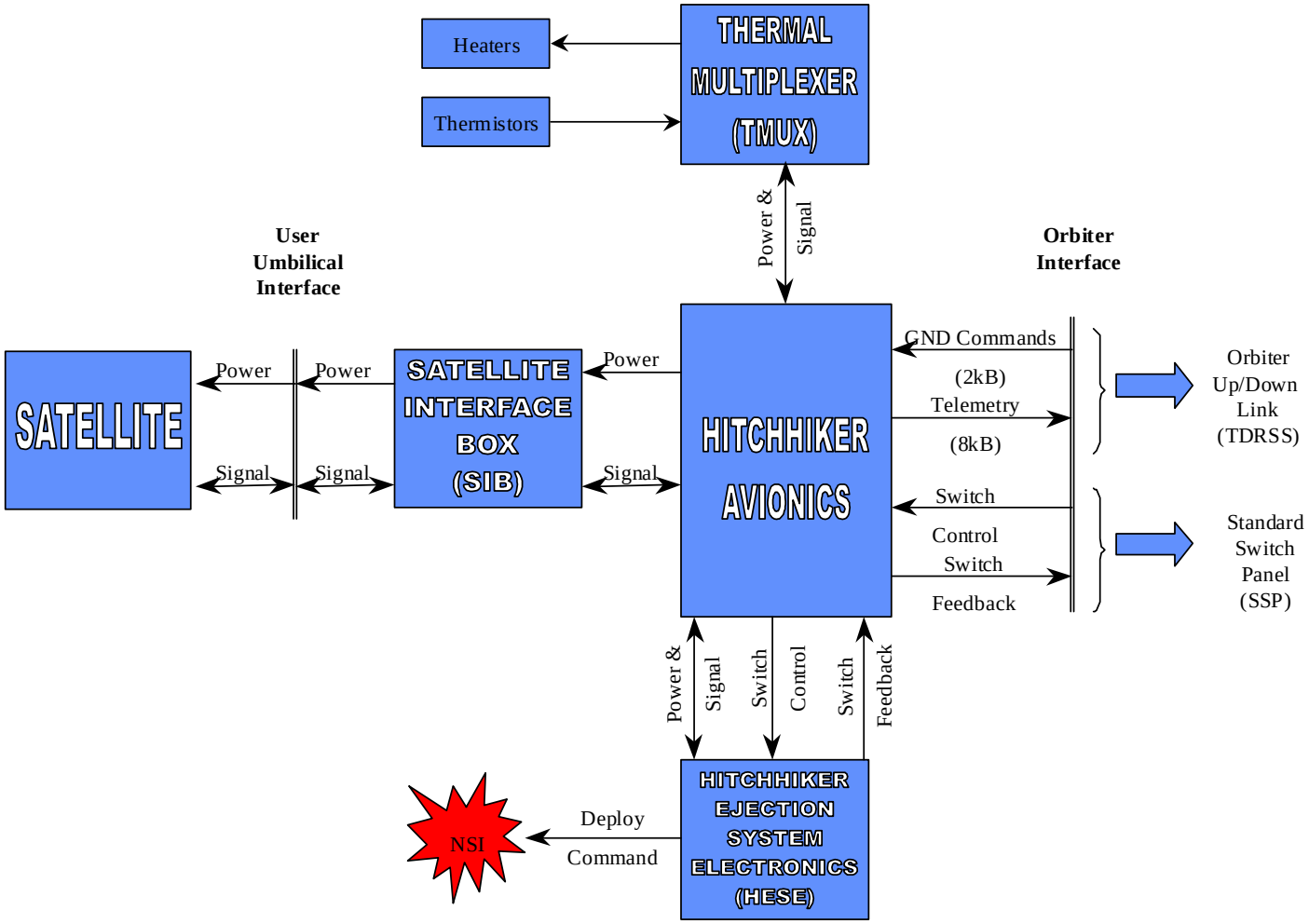
SIDEWALL ENVELOPE LOOKING AT ORBITER SILL



SIDEWALL ENVELOPE LOOKING DOWN THE ORBITER BAY

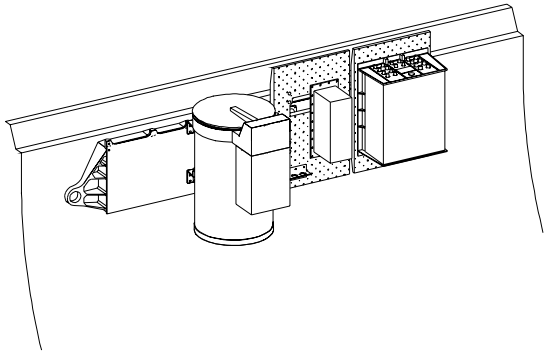


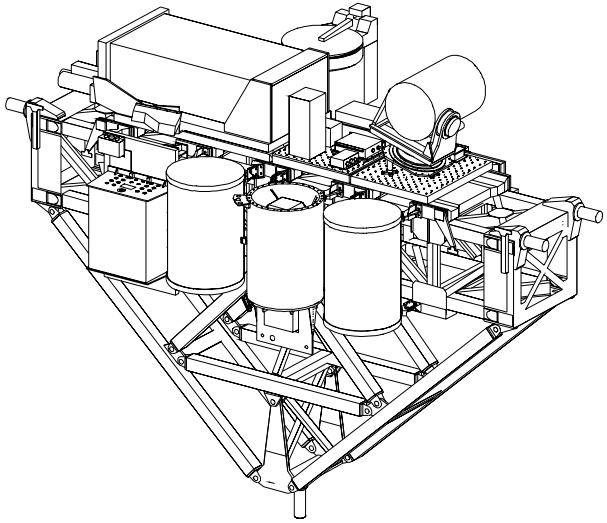



Heaters
Thermistors
THERMAL MULTIPLEXER (TMUX)
Power & Signal
User Umbilical Interface
Orbiter Interface
SATELLITE
Power
Power
Signal
Signal
SATELLITE INTERFACE BOX (SIB)
Power
Signal
HITCHHIKER AVIONICS
GND Commands
(2kB) Telemetry
(8kB)
Orbiter Up/Down Link (TDRSS)
Switch
Control Switch
Feedback
Standard Switch Panel (SSP)
Power & Signal
Switch
Control
Switch
Feedback
NSI
Deploy Command
HITCHHIKER EJECTION SYSTEM ELECTRONICS (HESE)

Hitchhiker Mechanical Accommodations

- The Hitchhiker carriers consist of modular equipment designed for either side-mounting or cross-bay mounting in the shuttle payload bay
- Hitchhiker mechanical mounting provisions:
  - 5 Cubic Ft. Canisters – Max 200 lb. (90 kg) Payload Weight
  - 19" diameter x 28" height
  - Motorized Door Option
  - Side Mount Plate – Max 305 lb. (138 kg) Payload Weight
  - Top Plate – Max 600 lb. (272 kg) Payload Weight





Hitchhiker Electrical Accommodations

- The current Hitchhiker Avionics System
  - Eight standard electrical interface "ports" for customer payloads
  - Each port provides the following:
    - *28V Power, Two 10A Circuits, up to 500W*
    - *Ground Command Interfaces*
    - *Time Signal*
    - *Low-rate Data Channel, up to 1200 Baud Downlink*
    - *Medium Rate Data Channel up to 1.4 MB Downlink*
- Additional electrical services are optional including CCTV interface for on-board recording and downlink, or for crew display and control interface
- Payloads are operated from a Payload Operations Control Center (POCC) located at GSFC